WORKING PAPER

ENVIRONMENTAL EVALUATION OF ALTERNATIVES FOR THE IMPROVEMENT OF BERKELEY MARINA BERKELEY, ALAMEDA COUNTY CALIFORNIA

PREPARED BY

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79 03131

WORKING PAPER

BERKELEY MARINA
BERKELEY, ALAMEDA COUNTY
CALIFORNIA

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SECTION 1

INTRODUCTION

A. PURPOSE OF ENVIRONMENTAL WORKING PAPER

This working paper is the first step towards assuring that environmental considerations are incorporated into the Corps of Engineers' planning process as required by Public Law 91-190, the National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. Sec. 4321 et sec. It should be noted here that a working paper is not an environmental statement but merely the first step in the environmental statement process. The purpose of a working paper is to establish early coordination with governmental agencies, environmental organizations, citizens' groups, and the general public by giving them the opportunity to comment on the working paper. Such early coordination with sources outside the Corps of Engineers is an essential element both in the evaluation and selection of an alterative plan of action and in the preparation of an environmental statement, should one be required.

The working paper outlines the planning objectives and the planning process, describes the environmental profile of the study area, discusses an array of alternatives that address the planning objectives, identifies the impacts associated with each alternative, and presents a preliminary evaluation of the alternatives. As the study progresses and more detailed information becomes available, elements of this working paper will be updated to reflect the more accurate conditions.

B. STUDY AUTHORIZATION

Section 107 of the River and Harbor Act of 1960, as amended, provides authority for the Chief of Engineers, together with a local sponsoring agency, to plan and construct small navigation projects that need not be individually authorized by Congress, if their total Federal cost does not exceed $2,000,000. A project is adopted for construction under Section 107 only after thorough investigations have shown it to be engineeringly sound, socially and environmentally desirable, and economically justified. This study was undertaken in response to a request by the City of Berkeley. In its resolution, (Resolution No. 47-654-N.S., dated 14 October 1975), the City of Berkeley requested that the Corps of Engineers, "initiate an investigation of construction of a breakwater extension and harbor entrance dredging at the City of Berkeley Marina under authority of Public Law 86-645, the River and Harbor Act of 1960, Section 107, as amended".

C. HISTORY OF STUDY

The Berkeley waterfront has been the subject of several investigations by the Corps of Engineers. A detached rubble-mound breakwater at the harbor entrance was constructed by the Corps in 1965 under Section 107 of Public Law 86-645. The breakwater is 725 feet long and it is aligned

approximately in a northwest-southeast direction, (N 25°W). It was designed to provide protection for the harbor against prevailing westerly winds and ocean-borne swells, making possible the addition of greater berthing capacity and boating safety. Rational for design and construction of the existing breakwater is described in a Detailed Project Report, Small-Craft Harbor Improvement, Berkeley, California, (U.S. Army Corps of Engineers, 1964).

D. PLAN OF ACTION

A plan for wave damage mitigation and navigation improvement at Berkeley Marina will be developed in three planning stages. The initial stage sets forth a plan of study to guide subsequent planning. During the intermediate stage a broad range of plans are developed and analyzed. The final stage involves screening these plans and developing detailed plans as a basis for selection and recommendation. The study of Berkeley Marina is presently in the intermediate stage of the planning process where alternatives are developed to provide initial choices as to the different viable resource management options available in the study area. Four iterative planning tasks are carried out during this and each of the other stages in the planning process. The following tasks are included: (1) Problem Identification, (2) Formulation of Alternatives, (3) Impact Assessment, and (4) Evaluation. These tasks, as they have progressed in this the intermediate stage of the planning process, are described throughout this working paper.

SECTION 2

PROBLEM IDENTIFICATION

A. INTRODUCTION

The first iterative task in the planning process consists of problem identification which is the determination of the range of resource problems the study will address. The problem identification task begins with the problems identified by the local agency that requested the study and culminates in the planning objectives which give direction to subsequent planning tasks.

Essentially three activities are performed during the problem idenfication stage. The first activity consists of the identification of public concerns regarding management in the study area. The second activity consists of the establishment of an environmental profile to identify the existing resource management problems in the study area. The third activity consists of the analysis of the most probable future conditions without a project to identify the future needs in the study area.

B. CONCERNS

The identification of public concerns has been accomplished through meetings and workshops with the harbor master and boaters and through the coordination with various agencies as discussed in Section 6. The following concerns and desires have been identified:

(1) Improve navigational safety, convenience, and pleasure.

(2) Maintain adequate flushing and water circulation in the harbor to maintain the water quality.

(3) Maintain or improve the visual quality.

(4) Control water pollution from construction and dredging activities.

(5) Retain the limited number of sport fishing and commmercial boats that now use the marina.

(6) Develop a plan that incorporates reliability, long life, and low future maintenance costs.

(7) Minimize possible adverse effects on marine and terrestrial biota.

C. PROBLEMS AND NEEDS

The development of the environmental profile, presented in Section 3, identifies the following problems in the study area:

(1) The damage to piers, berths, and boats that has been caused by waves entering Berkeley Marina.

(2) The navigational hazard created by the shoal at the entrance to the marina between the existing detached breakwater and the north jetty.

(3) The loss of boating opportunities caused by the above mentioned conditions.

The analysis of the future conditions without a project (the No Action alternative), which is addressed in Section 4B, identifies the following needs:

(1) To prevent future damages and the deterioration of the piers, berths, and small-craft exposed to waves entering the harbor.

(2) To remove the shoal that is located in the entrance to the harbor.

D. PLANNING OBJECTIVES

The activities carried out during the problem identification task culminate in the formulation of a set of planning objectives. In the first iteration, the following planning objectives have been formulated:

(1) To reduce the damages to private property and public facilities in Berkeley Marina.

(2) To increase the opportunities for recreational boating in the study area by allowing a more intensive use of boats berthed in Berkeley Marina.

(3) To improve the navigational safety and conveniance at the entrance to Berkeley Marina.

In future iterations, the planning objectives will be refined and presented in greater detail.

SECTION 3

ENVIRONMENTAL PROFILE

A. INTRODUCTION

1. Purpose of Environmental Profile.

The purpose of the environmental profile is to portray the existing conditions in the study area by describing the relevant physical, biological, social, and economic characteristics of the area. The environmental profile is necessary both in determining the planning objectives and for the iterative task of impact assessment. To accomplish this, the environmental profile is extended into the future to portray future environmental conditions without any action and this projection is then compared to the "with project" projection made for each alternative considered and the impacts are identified.

At the present stage in the planning process, a tentative environmental profile is prepared to give the readers of this working paper a basis for forming their own conclusions regarding the evaluation of the alternatives. As the alternatives are considered in greater detail, the environmental profile will become more precise, and focused on identified significant impact areas.

2. Definition of Study Area.

The study area is defined as the area in which the alternatives that meet the planning objectives will have an impact. A study area has been delineated that includes the Berkeley Marina and the areas immediately adjacent thereto. Included in the study area is the land area surrounding the marina as well as the area in the bay adjacent to the marina. The environmental profile in this working paper pertains to the study area as a whole unless otherwise stated.

The study area delineated in this working paper is located in the City of Berkeley, Alameda County, California about 8 miles northeast of San Francisco. The location of the study area is shown on Figure 1 and the extent of the study area is shown on Plate 1.

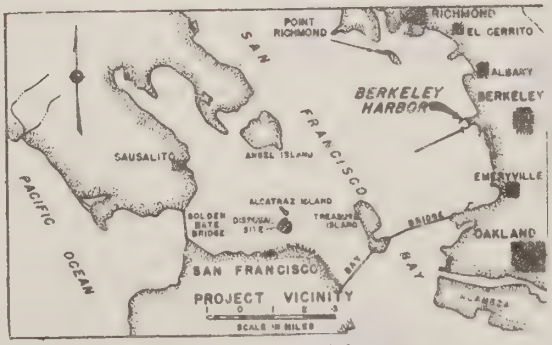
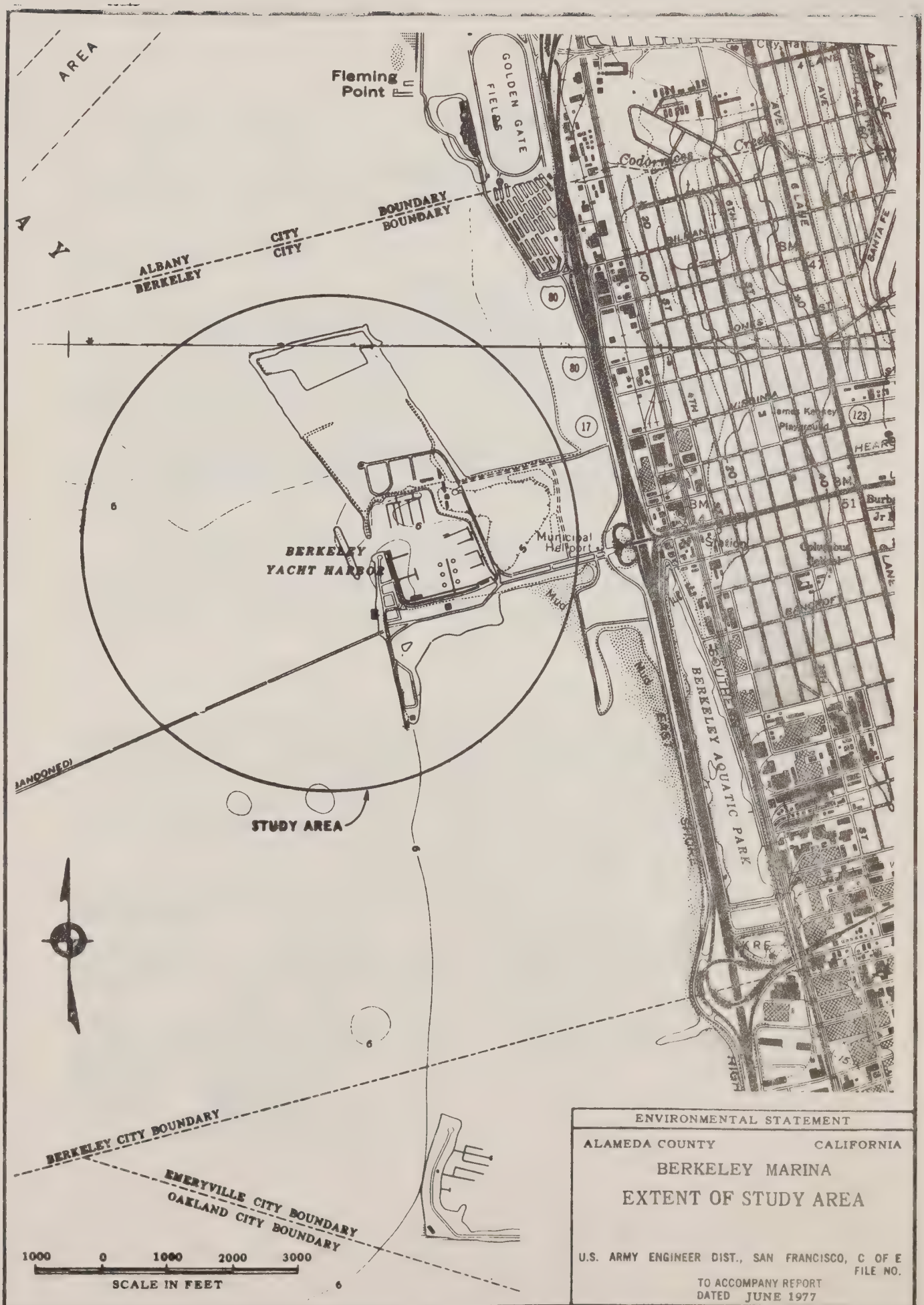


Figure 1. Location Map



ENVIRONMENTAL STATEMENT

ALAMEDA COUNTY CALIFORNIA

BERKELEY MARINA

EXTENT OF STUDY AREA

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
FILE NO.

TO ACCOMPANY REPORT
DATED JUNE 1977

PLATE 1

B. PHYSICAL ENVIRONMENT

1. Topography.

The study area is part of the San Francisco Bay region which is a topographic sub-unit within the California Coast Ranges geomorphic province. The San Francisco Bay region essentially consists of a fairly wide valley which separates the California Coast Ranges into two more or less parallel northwest-trending ridges, the Berkeley Hills to the east and the Marin-San Francisco Peninsula highlands and Santa Cruz Mountains to the west. The valley floor, which is partially inundated by the waters of San Francisco Bay, very gently slopes toward the submerged ancient river channels that make up the deeper portions of the bay.

The study area is located on the east-central shore of San Francisco Bay, on that portion of the valley floor that gently slopes from the base of the Berkeley Hills to the deeper portions of the bay. The study area itself, a man-made extension into the tidelands of the bay, has almost no topographic relief as shown on the aerial photographs on Plates 2 and 3.

Berkeley Marina, a man-made small-craft harbor occupies the westernmost portion of the study area. The main feature of the marina is the 56-acre boat basin. Offshore from the entrance to the harbor lies a detached rubble-mound breakwater that was constructed by the Corps of Engineers in 1965.

2. Hydrography.

The hydrographic features in the study area reflect the fact that it is located on the submerged gently sloping valley floor. At the entrance to the marina, the bay water is about six feet deep. From this location, the bottom of the bay extends westward at an extremely gentle slope requiring 2.6 miles to reach the 12-foot depth contour and an additional 1.4 miles to reach the 30-foot depth contour. The hydrography is shown on Plate 4.

A shoal exists at the north entrance between the existing detached breakwater and the north jetty. This shoal further reduces the depth of the already shallow waters in the study area.

PLATE 2

AERIAL PHOTO OF BERKELEY MARINA (LOOKING NORTH) WITH THE SANITARY LANDFILL IN THE IMMEDIATE BACKGROUND AND THE CITY OF RICHMOND IN THE FAR BACKGROUND.

AERIAL PHOTO OF BERKELEY MARINA (LOOKING EAST) WITH THE CITY OF BERKELEY AND THE BERKELEY HILLS IN THE BACKGROUND. THE EXISTING DETACHED BREAKWATER IS IN THE FOREGROUND

PLATE 3

ENVIRONMENTAL STATEMENT

ALAMEDA COUNTY CALIFORNIA

BERKELEY MARINA

HYDROGRAPHY

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E

FILE NO.

TO ACCOMPANY REPORT DATED JUNE 1977

PLATE 4

3. Geologic Conditions.

a. Site Geology and Foundation Conditions. The study area is underlain by alluvial deposits ranging in age from mid-Pleistocene to Holocene. Formations older than these are buried so deeply that they have no effect on the foundation conditions under the study area. The mid-Pleistocene to Holocene deposits consist of two distinct layers of material. The upper layer, six to ten feet thick, is composed of silty clays and clayey silts. This very soft to soft layer is locally known as "bay mud". The lower layer consists of over-consolidated dense sands and clays.

b. Geologic Hazards. The study area is located in a seismically active region which means that any structural solution to the problem would have to consider the hazards of a major seismic event within the region. Associated with such an event are hazards like liquefaction and settlement. Tsunamis from a distant earthquake could also enter San Francisco Bay and affect any structural solution.

4. Pedology - Prime and/or Unique Farmland.

The landward portion of the study area is man-made and consists of a perimeter dike inclosing various types of fill material including rock, broken concrete and sanitary landfill material. Thus there are no prime or unique farmlands within the study area.

5. Climate.

The climate in the study area is classified as "Mediterranean", cool summer with fog. This climate type is characterized by cool summers, mild winters, frequent fogs and a pronounced seasonal precipitation.

The temperature in the study area is moderate with few extremes. It ranges from a high mean of 62° F. in July to a low mean of 49° F. in Janaury.

Approximately 80% of the precipitation in the study area is received during the period from November to March.

The prevailing westerly wind that sweeps the study area is one of the more significantly climatic factors. Since the study area is located almost directly east of the Golden Gate, the entrance to San Francisco Bay, it is exposed to a flow of cool moist air from the Pacific Ocean most of the time, as shown by the wind rose on Plate 7.

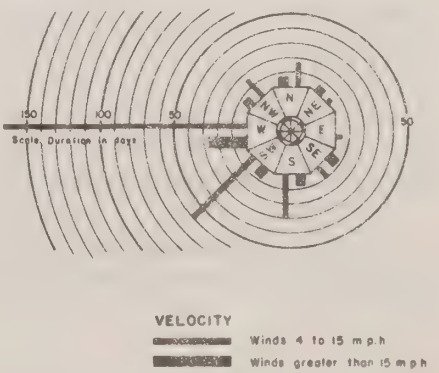


Figure 2. Wind Rose, Berkeley Marina

6. Air Quality.

There are no air quality monitoring stations within the study area. The closest stations maintained by the San Francisco Bay Area Air Pollution Control District are located in Richmond and Oakland. Although the ambient air quality standards were exceed during a few days in 1975 at these two stations, the local ambient air quality at the study area is considered good. This is due mainly to the exposure of the study area to the prevailing westerly wind. This flow of clean marine air from the Pacific Ocean disperses local emissions and keeps the air clean in the study area.

The only local sources of pollutants are the operation of the sanitary landfill, the trucks traveling to and from the sanitary landfill, power-driven boats and the local auto traffic, and the traffic along Interstate 80.

7. Noise.

The only sources of noise in the study area are the equipment operating the sanitary landfill, the vehicular traffic along the roads, boats entering and leaving the harbor, and occasional overflights by aircraft operating from Oakland Airport, or from Alameda Naval Air Station. These sources, however, do not generate objectionable or harmful noiselevels. The noiselevels in the immediate vicinity of the sanitary landfill are very high due to the operation of the diesel-powered equipment and the numerous dumptrucks entering and leaving the area. These noiselevels are, however, isolated from the rest of the study area and they are therefore not considered objectionable.

The study area overall is very quiet, no doubt due to the fact that it is almost surrounded by water which acts as a noise barrier filtering out the noise of the urbanized San Francisco Bay Region.

8. Water Quality.

The Corps of Engineers sampled and tested the sediments and the water outside the harbor entrance and Engineering-Science Inc. sampled and tested the water in San Francisco Bay outside the harbor and in the vicinity of the study area. These samples indicate that the water generally is of good quality and can support even the most demanding organisms. (Engineering-Science Inc., 1976 and U.S. Army Corps of Engineers, 1977). The City of Berkeley moniters the water quality inside the harbor on a regular basis and the latest samples taken in December 1976 indicate that the water quality in the marina meets the water quality standards relating to ocean water contact sports.

The result of the sediment sample analysis performed by the Corps of Engineers is presented in Appendix C.

9. Wave Conditions.

The most common wave condition in the study area consists of waves generated by the prevailing westerly wind and ocean-borne swells entering through the Golden Gate. These waves impinge upon the detached breakwater but do not enter the harbor. Occasionally, winds acting on the fetch of open water inside the bay generate waves that reach the study area. The most significant of these are the waves coming from the sector west to northwest because such waves enter the harbor through the gap between the detached breakwater and the north jetty and strike piers, berths, and boats moored inside the harbor.

10. Water Circulation/Currents.

The hydrographic, wind, and tidal conditions on the east side of San Francisco Bay are such that no dominant currents are formed. Although the wave conditions and the prevailing winds tend to move the water shoreward, no pronounced littoral drift is formed. The water circulation in the vicinity of the study area is partially caused by the winds, but the primary mover of water is the tidal action, which moves water in and out of the harbor twice daily.

11. Tidal Data.

Mean tidal planes for gage No. 941-4916 (Formerly located near the Berkeley Municipal Pier) have been calculated and published (1965) by the National Ocean Survey as follows: 1/

	Elevation in Feet (MLLW)
Highest tide of record	8.6 2/
Mean higher high water	5.9
Mean high water	5.3
Mean tide level	3.2
Mean low water	1.1
Mean lower low water	0.0 datum
Extreme low water	-2.5

1/ Based on six month record from Sept 1932-March 1933.
2/ Estimate of extreme high water changed to 9+ feet, based on more recent events read at other gages maintained in San Francisco Bay.

12. Shoaling Pattern.

A 5-acre shoal has formed in the north entrance to the harbor between the detached breakwater and the North Jetty. The shoal is presently a hazard to navigation and the harbor management has to post a pilot in a skiff during low tide to guide the heavy traffic in and out of the harbor.

C. BIOTIC ENVIRONMENT.

1. Introduction.

The biotic resources of the San Francisco Bay area encompass a large number of distinct yet inter-related ecosystems. Man and terrestrial wildlife together with fish, marine mammals, water birds, marine benthic organisms, plankton, algae, plant life are all part of the biotic environment within and surrounding San Francisco Bay. Most of the components of the Bay environment may be found within the Berkeley Marina area. For purposes of discussing these components, this section has been categorized into three general habitat types: marine (water area), shore (shallow water-land interface), and terrestrial (adjacent land area).

2. Marine Habitat.

The marine habitat of the study area includes the open water surrounding the marina and the aquatic area enclosed by the marina. Marine life is both resident and transient since there exists both sedentary and free-moving forms. Free-swimming fish are prevalent and movement of migrating fish species (anadromous) to spawning areas occurs seasonally as they travel from sea life to freshwater life through the Bay. Through angling at the nearby shoreline and Berkeley Pier and sampling, the following fish are known to be present in waters in and around the marina: Striped bass, Cabezon, Staghorn Sculpin, Jacksmelt, Rockfish, Starry Flounder, Kingfish, Bat Ray, Diamond Turbot, Oriental Goby, Brown Smoothhound, Leopard Shark, and various types of perch.

Common sedentary marine life includes but is not limited to annelid marine worms, barnacles, mussels, and clams. The bay mussel and various barnacles are often observed attached to pilings, rocks, and scrap at the marina.

3. Shore Habitat.

The shoreline habitat adjacent to the Berkeley marina is somewhat limited. Shorebirds frequent mainly quiet areas adjacent to the marina keeping away from human activities within the marina itself. A shorebird census, conducted with direction from the California Department of Fish and Game in 1974 recorded the occurrence of shorebird sightings of individual species over a five-year period at Golden Gate Fields located to the north near Albany; one of many designated census sites in and around the Bay. A list of individual species designated as shorebirds and occurring at the site is attached as Appendix A.

In addition to shorebirds, waterfowl and other water-associated birds, such as gulls, terns, pelicans and cormorants, are widely distributed throughout San Francisco Bay. The most abundant species of waterfowl in the San Francisco Bay-Delta geographical complex includes puddle ducks and diving ducks. Not all of the waterfowl species are found at the Berkeley marina area for long periods of time, since large wildlife refuges and wintering areas are located elsewhere in the Bay Area. Species lists of commonly observed birds at the Berkeley marina area have been developed for Berkeley's Environmental Inventory by the City Planning Department. (Spectrum Northwest, 1976)

4. Terrestrial Habitat.

Terrestrial habitat near the Berkeley marina area is more restricted than the shoreline habitat type. One barrier to terrestrial wildlife migration is the Eastshore Freeway. Heavy traffic makes access to the shoreline more difficult from the interior. However, the landfill area to the north of the marina may be inhabited by several small mammal species including the Norwegian Rat, House Mouse, Pocket Gopher, California Vole, Black-tailed Jackrabbit, Feral House Cat, Roof Rat, Ornate Shrew, and possibly the Salt Marsh Harvest Mouse. To date, no confirmed sightings of the Salt Marsh Harvest Mouse have been recorded. Bats have also been occasionally observed in the early morning.

5. Rare and Endangered Species.

Although no site surveys have been conducted in the study area, specific surveys in nearby areas, both north and south, have indicated the presence of the Salt Marsh Harvest Mouse and the California Clapper Rail, both of which are listed by the Federal and State Wildlife agencies as rare and endangered species. The habitat available in the study area does not appear to be adequate to support either species. The Salt Marsh Harvest Mouse and the California Clapper Rail require a marsh habitat consisting of pickle weed, cord grass, and small tidal channels. In the case of the California Clapper Rail it is desirable that the marsh contain the ribbed horse mussel. In addition, the heavy recreational use associated with the marina produce conditions that are not conducive to the presence of either species. It therefore seems doubtful the either species resides or frequents the Berkeley Marina area.

The Inventory of Rare and Endangered Vascular Plants of California has been consulted and no rare or endangered plant species have been indicated in the immediate area of the Berkeley Marina.

D. SOCIO-ECONOMIC ENVIRONMENT

1. General Social Environment.

The study area is located in the large metropolitan San Francisco Bay Area which has a total population exceeding 4.5 million according to the 1970 Census. The study area itself is, however, used strictly for commercial and recreational purposes. There is no residential development within the study area. The area is also separated from the City of Berkeley proper by a large undeveloped area and the eight-lane freeway, Interstate 80.

2. Recreational Opportunities.

The study area provides opportunities for varied recreational pursuits such as boating, fishing, bicycle riding, hiking and dog training.

a. Boating. The prime recreational resource in the study area is the Berkeley Marina with its oppotunities for boating on San Francisco Bay. Since its opening, the Berkeley Yacht Harbor has established itself as a highly desirable marina. This is due to its convenient location, attractiveness, and the fact that the City has maintained the entrance, the waterway, the berthing piers and other facilities in a good state of repair. The harbor which operates on a year-round basis, contains berths for approximately 980 power and sail boats having lengths from 16 to 75 feet. There are also 50 additional berthing spaces used for temporary docking, and 40 tie-up spaces for skiffs and other minor craft. The marina also has a launching ramp which handles about 10,000 boats a year.

The usefulness of the marina in providing boating opportunities is currently below potential due to wave damage inside the harbor, the shoaling between the existing detached breakwater and the north jetty, and the generally shallow water between the harbor entrance and the deeper water of the bay.

The detached breakwater is designed to protect the harbor entrance from the predominant westerly winds and swells. However, waves from the west to northwest, though infrequent, have on occasion passed the north end of the breakwater and entered the harbor. These wind-generated waves are now causing progressively worse damage to the recently constructed berthing areas just inside and to the south of the harbor mouth. Damage to boats has also occurred in the same general area. More serious damage and possible loss of some expensive yachts berthed on the north finger extensions of Pier "0" were prevented only through timely action by harbor maintenance personnel during two critical storm events since 1973.

The shoal in the north passage to the harbor entrance is a hazard to navigation and it reduces the boating opportunities by restricting the accessibility to open water. The generally shallow water both inside the marina and between the harbor and the deeper water of the bay also restricts boating opportunities. Currently, many of the larger sailboats berthed at the marina can only depart and return to the harbor during high tide. Groundings have occurred not only in the north passage but in other places in the vicinity of the marina, both north and south of the detached breakwater.

b. Fishing. Fishing is a very popular recreational activity in the study area. The municipal pier just south of the harbor is heavily used for fishing, especially by youngsters. Some fishing also takes place from the shoreline. Berkeley Marina is also the departure point for sport fishing boats.

c. Other Recreational Opportunities. Bicycle riding is quite common along the roads in the study area especially on the weekends. Hikers also use the area, particularly along the shoreline. The open space areas in the study area are informally used by dog owners to train their dogs.

3. Aesthetic Quality.

The aesthetic quality of the study area varies considerably from one portion to the other. The operating sanitary landfill portion of the study area presents views of a polluted pond, exposed garbage and debris of all kinds, and blowing dust; not a very pleasant sight. The open space areas between the marina and the freeway gives the appearance of a vacant lot, overgrown with native vegetation. The distant vistas and views from the marina and the southern portion of the study area are excellent and present an unobstructed view of San Francisco, the Golden Gate Bridge, the hills of Marin County and of San Francisco Bay with its ships and sailboats.

4. Cultural Resources.

A thorough literature search was performed for the study area. The search included, but was not restricted to, examination of records and maps on file at the California Archaeological Survey in Sacramento, Oakland Public Library, California Room; and Corps of Engineers' collection of navigation charts and topographic maps. The Preliminary Map of Historic Margins of Marshland, San Francisco Bay, California (Nichols and Wright, 1971) was also consulted. No records or indication of archaeological or historic resources were found.

Sediment samples to a maximum depth of -20 feet MLLW taken by the Corps of Engineers were examined and analyzed for the presence of cultural or paleontological resources. There was no indication of the presence of submerged cultural or paleontological resources.

No cultural resources are known to exist within the proposed dredged materials disposal site, and the likelihood that such resources may exist is considered remote. The possible land disposal area has been subject to extensive modification due the current land use as a sanitary landfill operated by the City of Berkeley.

5. Land Use and Economic Development.

The total land area within the study area consists of approximately 250 acres plus about 60 acres of water surface in the boat basin. Municipally owned lands within the study area total about 220 acres with 60 acres used for the boat basin, 70 acres immediately adjacent to the harbor in use for the marina complex and about 90 acres used for the sanitary landfill. The remaining approximately 90 acres are privately owned undeveloped land. Plate 5 shows an aerial photograph of the marina and vicinity.

6. Public Facilities.

The public facilities within the study area consist of the marina, auxiliary marina facilities, and privately owned restaurants and service establishments on lands leased from the City of Berkeley.

The existing small-craft harbor, locally known as the "Berkeley Yacht Harbor" was constructed under a Public Works Administration Program in 1936. The city-owned marina consists of a 56-acre boat basin with approximately 70 acres immediately adjacent to the harbor developed into a marina complex. A rubble-mound jetty and an 850-foot long mole form the west side of the boat basin. The entrance to the basin is about 300 feet wide with a 725-foot long detached breakwater about 500 feet offshore opposite the entrance. The small-craft harbor and adjacent areas are shown on Plate 5.

The marina now contains berths for 980 craft varying in length from 16 to 74 feet. An additional 50 berthing spaces are available for temporary docking as well as 40 tie-up spaces for skiffs and other small craft.

The city now maintains extensive supporting facilities for the marina. It has invested over $3 million in new berthing piers, landscaping, utilities, and renovation of the municipal fishing pier. These improvements have been financed with grants from the California Fish and Game Commission for renovation of the fishing pier in 1958, and loans from the California Department of Navigation and Ocean Development totaling $2.75 million. The cost of the marina administration, maintenance, and amortization of debts is supported by income from berth rentals, boat launchings, and other operations including land leases to concessionaires.

City-owned structures and utility improvements have a current estimated replacement value of $6 million. Privately-owned restaurants, marine service station, bait shop and hotel improvements on leased lands

AERIAL VIEW OF BERKELEY MARINA AND ADJACENT LANDS (CIRCA 1974).

PLATE 5

have an estimated fair market value of $4.7 million and produced gross revenues estimated in excess of $7.1 million in 1975. Existing berthing facilities had an occupancy rate of 100 percent in 1975 and other facilities have a comparable rate of utilization. Existing auxiliary marina facilities are listed and classified as to general function in Appendix B.

E. ENVIRONMENTAL RELATIONSHIP MATRIX

The environmental relationship matrix that follows was developed by identifying the environmental relationships that exist within the study area. These relationships will provide information to be used in assessing the ecosystem's response to natural changes and man-made changes either directly or indirectly associated with the alternatives.

When analyzing the environmental relationship matrix, it should be remembered that columns act upon rows and that the relationships indicated are the primary relationships.

PASSIVE ELEMENTS / ACTIVE ELEMENTS	PHYSICAL ELEMENTS	Hydrography	Wave Conditions	Water Circulation	Water Quality	Sedimentation	BIOTIC ELEMENTS	Marina Habitat	Shoreline Habitat	Terrestrial Habitat	Rare & Endangered Species	SOCIO-ECONOMIC ELEMENTS	Public Facilities	Recreational Opportunities	Local Government Finance	Cultural Resources	Private Property
PHYSICAL ELEMENTS																	
Hydrography			T	T		C											
Wave Conditions	C												M				
Water Circulation	T	C											T				
Water Quality				C													
Sedimentation		T	M														
BIOTIC ELEMENTS																	
Marina Habitat	T		T	C									S				
Shoreline Habitat		T		M													
Terrestrail Habitat				T													
Rare & Endangered Species				T													
SOCIO-ECONOMIC ELEMENTS																	
Public Facilities		C		T	M									T	T		
Recreational Opportunities	M	T		T	M								C	T		M	
Local Government Finance				T									S	S	T		
Cultural Resources	T																
Private Property		C															

LEGEND

C = critical relationship
M = moderate relationship
S = slight relationship
T = theoretical relationship (not identified in study area)

SECTION 4

ARRAY OF ALTERNATIVE MANAGEMENT MEASURES

A. INTRODUCTION

The intermediate stage of the planning process emphasizes developing an array of management measures for achieving the planning objectives. How well the alternative measures address the objectives will form part of the basis for choosing among the alternative management measures when developing a management plan. The task of alternative formulation receives considerable attention during the present iteration of the planning tasks. During the final iteration, this task will not be emphasized since the range of measures specifically applicable to the study will be reduced and become more precise.

B. THE NO ACTION ALTERNATIVE - FUTURE CONDITIONS WITHOUT A PROJECT

1. Description of the Alternative.

In an area such as the study area, the environmental conditions would be expected to change with time in response to changing physical, biological, and socio-economic characteristics. Changes in the environment take place in response to natural on-going processes and to man's activities and such changes will take place regardless of whether any structural or non-structural measures are implemented.

2. Impacts of the Alternative.

a. Effects on the Physical Environment. The future physical conditions in the study area are not expected to change significantly if the No Action alternative is adopted. Changes could be expected to take place in the bottom configuration in the area between the existing detached breakwater and the north jetty where shoaling is presently taking place. The process of shoaling is expected to continue and, with time and without any remedial action, this shoal can be expected to become a major navigational hazard.

Since no significant changes in the hydrology are expected in the future, the existing wave conditions would remain unchanged and waves from the sector west-northwest would continue to enter the harbor.

b. Effects on the Biotic Environment. No significant changes are expected to occur in the biotic environment if the No Action alternative is adopted.

c. Effects on the Socio-Economic Environment.

(1) Public Facilities. As the wave action in the harbor is expected to continue, the damages to piers and berths in the harbor is expected to get progressively worse. The result of this deterioration would be the eventual abandonment of these public facilities in the harbor.

(2) Private Property. The continuing wave action inside the harbor would have an adverse impact on private property represented by privately-owned small-craft berthed in Berkeley Marina. Boats would continue to suffer damage from incoming waves as long as the existing conditions remain unchanged.

(3) Recreational Opportunities. The deterioration of piers and berths and the eventual abandonment of such facilities would have an adverse effect on the boating opportunities in the study area. The boats berthed at the damaged piers would have to be relocated to other marinas thus reducing their usage.

The shoal in the north passage would become a greater navigational hazard with time and would restrict the use of the north passage to only the most favorable tidal conditions. The combination of the loss of berthing space and the restriction in use of the north channel would mean a net loss in recreational benefits to the study area.

(4) Local Government Finance. The finances of the City of Berkeley would be affected in two ways. First, the city would suffer a financial loss due to the wave destruction of public facilities in the marina. Second, the subsequent relocation of the boats from the damaged piers to other marinas would mean a loss of slip rental revenue to the city.

C. THE RELOCATION ALTERNATIVE

1. Description of the Alternative.

The concept of this management measure is to relocate those small-craft that are exposed to incoming damaging waves from west-northwest. The relocation could consist of either the permanent relocation of the exposed small-craft to other marinas around San Francisco Bay, since there is no space available within Berkeley Marina, or the temporary relocation of exposed boats to other parts of Berkeley Marina when damaging waves are expected, and the maintenance and replacement of existing piers and berths.

The relocation alternative is a non-structural management measure that addresses the planning objective which calls for the reduction of damages to boats and public facilities in Berkeley Marina.

The estimated costs for this alternative have not been determined.

2. Impacts of the Relocation Alternative.

a. Introduction. An impact tree, tracing the cause and effect relationships of the relocation alternative, was constructed to trace the impacts associated with this alternative. The significant impacts and impacts of the first level of insignificance thusly identified are described in the sections that follow. Unless otherwise stated, the impacts discussed apply to both variations of the relocation alternative. The impact tree on Plate 6, is based on the environmental relationship matrix shown on page 16.

b. Effects on the Physical Environment. Implementation of the relocation alternative would have very slight, if any impact on the physical environment in the study area. With the relocation of the exposed boats to other marinas and the abandonment of damaged piers and berths, the incoming waves would be able to penetrate deeper into the harbor to damage marina facilities and boats that presently are protected against wave action.

c. Effects on the Biotic Environment. The relocation alternative is not expected to have any significant impacts on the biotic environment.

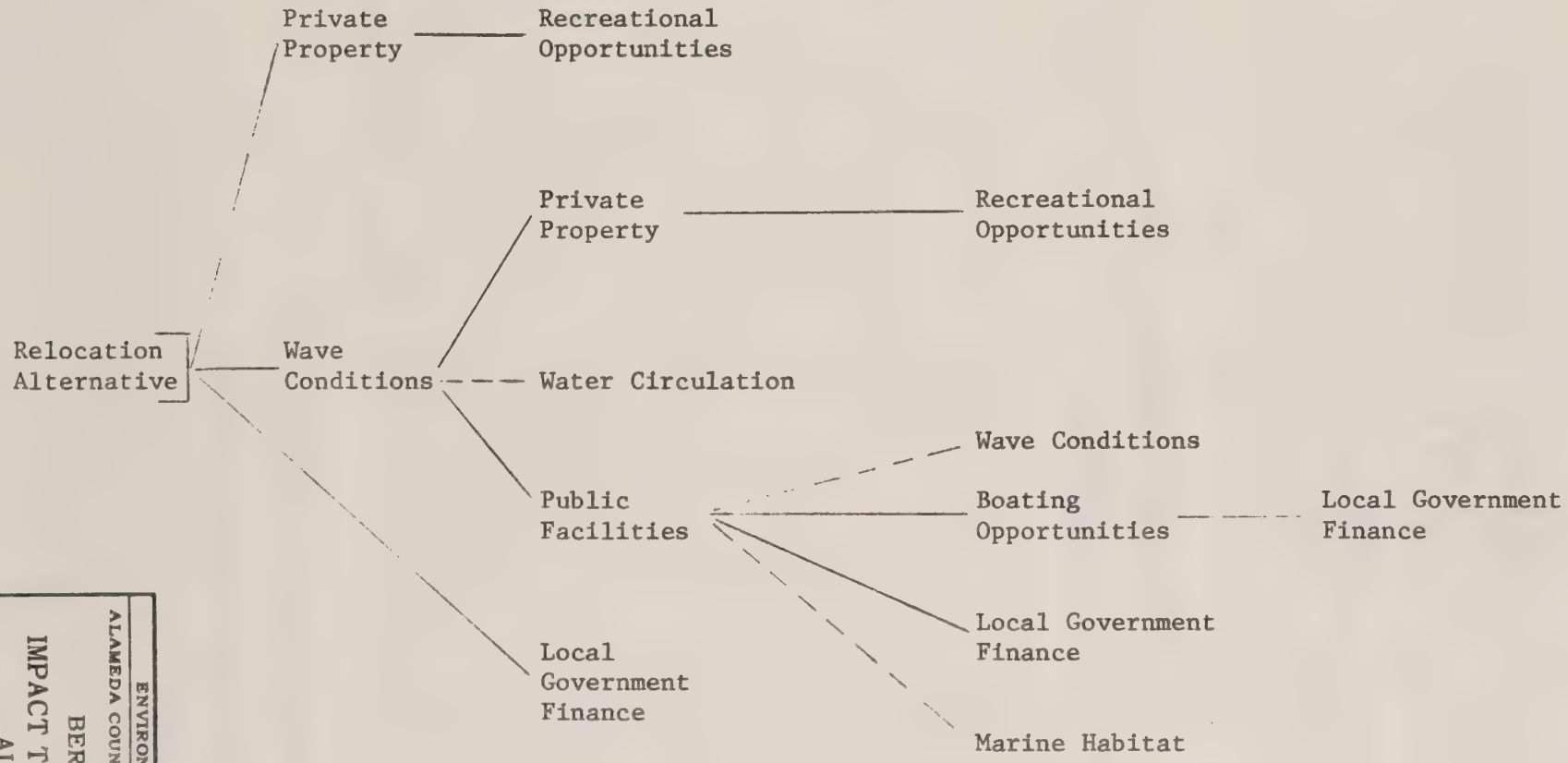
d. Effects on the Socio-Economic Environment.

(1) Recreational Opportunities. Boating opportunities could be restricted for some boatowners under the relocation alternative. The variation of the relocation alternative that calls for a permanent relocation of the boats exposed to incoming waves would have a significant impact on the recreational opportunities for boatowners residing near Berkeley Marina. Boatowners, whose boats were relocated to other marinas around the bay, would have to travel greater distances to use their boats and this extra travel would limit the boating opportunities for those boatowners.

The variation that calls for the temporary relocation of the exposed boats to other portions of the marina prior to the arrival of damaging waves would not have a direct impact on the boating opportunities.

Under both variations the boating opportunities would be reduced with time since the boats to be relocated presently provide protection for boats located deeper into the harbor by dissipating the energy of incoming waves.

IMPACT TREE
RELOCATION ALTERNATIVE
BERKELEY MARINA



NOTE: The lines in this illustration are to be read as:

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- - - - Does not have a significant effect on ...

ENVIRONMENTAL STATEMENT

ALAMEDA COUNTY CALIFORNIA

BERKELEY MARINA

IMPACT TREE - RELOCATION ALTERNATIVE

IN SHEET NO.

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E

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TO ACCOMPANY REPORT

DATED JUNE 1977

PLATE 6

(2) Public Facilities. The relocation of the boats to other marinas would have an adverse effect on public facilities such as piers and berths. Incoming damaging waves would still arrive in the harbor and with the exposed boats relocated a larger portion of the harbor would be subject to the wave action and subsequent damage.

(3) Private Property. The primary purpose of either of the two variations of the relocation alternative is to protect private property, the small-craft berthed in the marina. The relocation of the small-craft to prevent wave-induced damage would be a beneficial economic impact for the owners of this private property.

(4) Local Government Finance. The finance of the City of Berkeley would be affected by the implementation of the relocation alternative in various ways depending on whether the permanent relocation variation or the temporary relocation variation is adopted.

If the permanent relocation variation were adopted, the finances of the local government would be affected in three ways. First, there would be an immediate loss of rental revenue due to the relocation of the boats to other marinas. Second, since the wave action would continue in the harbor, the abandoned piers and berths would eventually be destroyed and such premature losses would be a direct financial loss to the city. Third, higher maintenance costs would be incurred by the city in protecting the remaining piers and berths in the marina.

If the temporary relocation variation were adopted, the finances of the City of Berkeley would be affected in three ways. First, the wave action inside the harbor would continue, the deterioration of piers and berths would continue which would lead to a higher cost for maintenance and replacement of those public facilities. Second, the relocation of boats exposed to damaging wave action when such waves are expected would be an expenditure for the city of Berkeley. This expenditure would include salaries and liability insurance. Third, since this variation is dependent upon the alert action of harbor personnel there is an element of risk involved. Craft subject to frequent relocations may independently choose to relocate permanently to other marinas around San Francisco Bay thereby reducing the rental revenues for the City of Berkeley.

D. THE BREAKWATER EXTENSION ALTERNATIVE

1. Description of the Alternative.

An extension of the existing detached breakwater would intercept waves coming from the sector west-northwest and thereby prevent such waves from entering the harbor to damage marina facilities and boats. The breakwater extension alternative would thus mitigate future damages to public and private property.

The extension to the existing breakwater could be constructed either as a stone rubble-mound breakwater or as a steel, concrete, or timber pile breakwater. Each variation could in turn be designed in various length/alignment variations depending on the protection desired. The alignment variations are shown on Plate 7.

Based on the findings of a wave analysis, five length/alignment variations of the breakwater extension were developed. These variations are summarized in Table 1.

TABLE 1

BREAKWATER EXTENSION VARIATIONS

Variation	Alignment	Length
1	N 24°49' W	275 feet
2	North	200 feet
3	North	330 feet
4	N 20°10'E	190 feet
5	N 20°10'E	290 feet

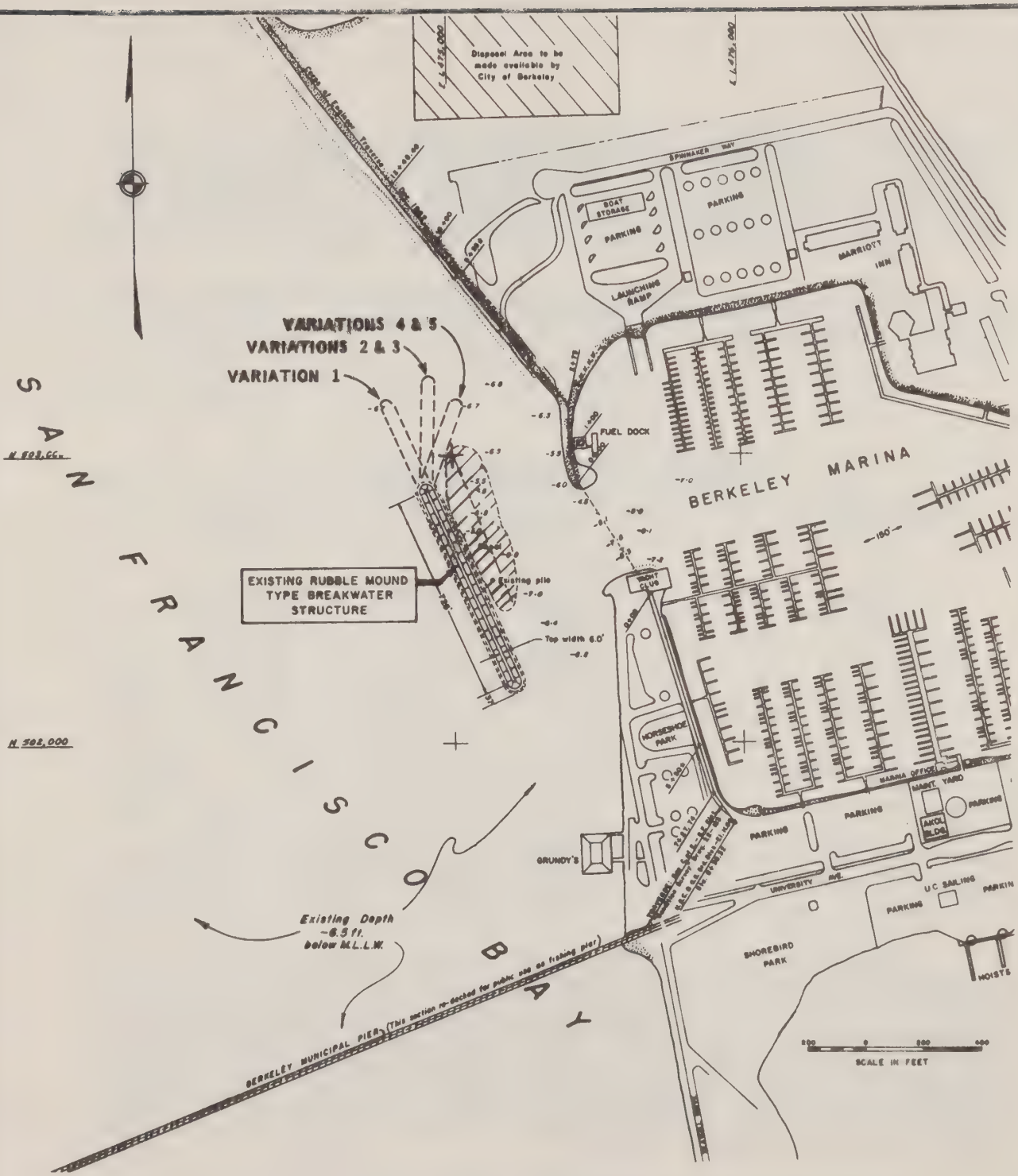
The analysis of the various variations showed that to prevent waves from entering the harbor directly through the 170-foot wide corridor an alignment of the extension of N 24°49'W (same as existing breakwater) would have to be 275 feet long, an alignment of due north would need to be 200 feet long, and an alignment of N 20°10'W would need to be 290 feet long.

To construct the rubble-mound breakwater extension, it will be necessary to dredge six to ten feet of the soft bay mud in order to locate the structure on a foundation firm enough to resist excessive settlement. It is expected that this excavation, 12,000 cubic yards, would be done with a small clamshell dredge mounted on a barge. The dredged material would be deposited at either the sanitary landfill site north of the marina or it would be barged to the disposal site in San Francisco Bay near Alcatraz Island.

Construction materials for the rubble-mound breakwater would probably be obtained from an operational quarry.

The breakwater extension alternative is a structural management measure that addresses the planning objective that calls for a reduction in damages to boats and public facilities inside the harbor.

The estimated costs of this alternative range from $600,000 to $900,000 depending on which variation is selected.



ENVIRONMENTAL STATEMENT

ALAMEDA COUNTY CALIFORNIA

BERKELEY MARINA
BREAKWATER EXTENSION
ALTERNATIVE

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E FILE NO.

TO ACCOMPANY REPORT
DATED JUNE 1977

PLATE 7

2. Impacts of the Breakwater Extension Alternative.

a. Introduction. An impact tree, tracing the cause and effect relationships of the breakwater extension alternative, was constructed to trace the impacts associated with this alternative. The significant impacts and impacts of the first level of insignificance thusly identified are described in the sections that follow. Unless otherwise stated, the impacts discussed apply to all variations of the breakwater extension alternative. The impact tree on Plate 8 is based on the environmental relationship matrix shown on page 16.

b. Effects on the Physical Environment.

(1) Wave Conditions. The immediate effect of the implementation of the Breakwater Extension Alternative would be a change in the wave conditions since the completed extension would prevent waves from the sector west-northwest from entering the harbor.

(2) Water Circulation. The water circulation in the harbor is not expected to be affected to any great degree since the major flushing action is provided by the tidal movement of water in and out of the harbor twice daily.

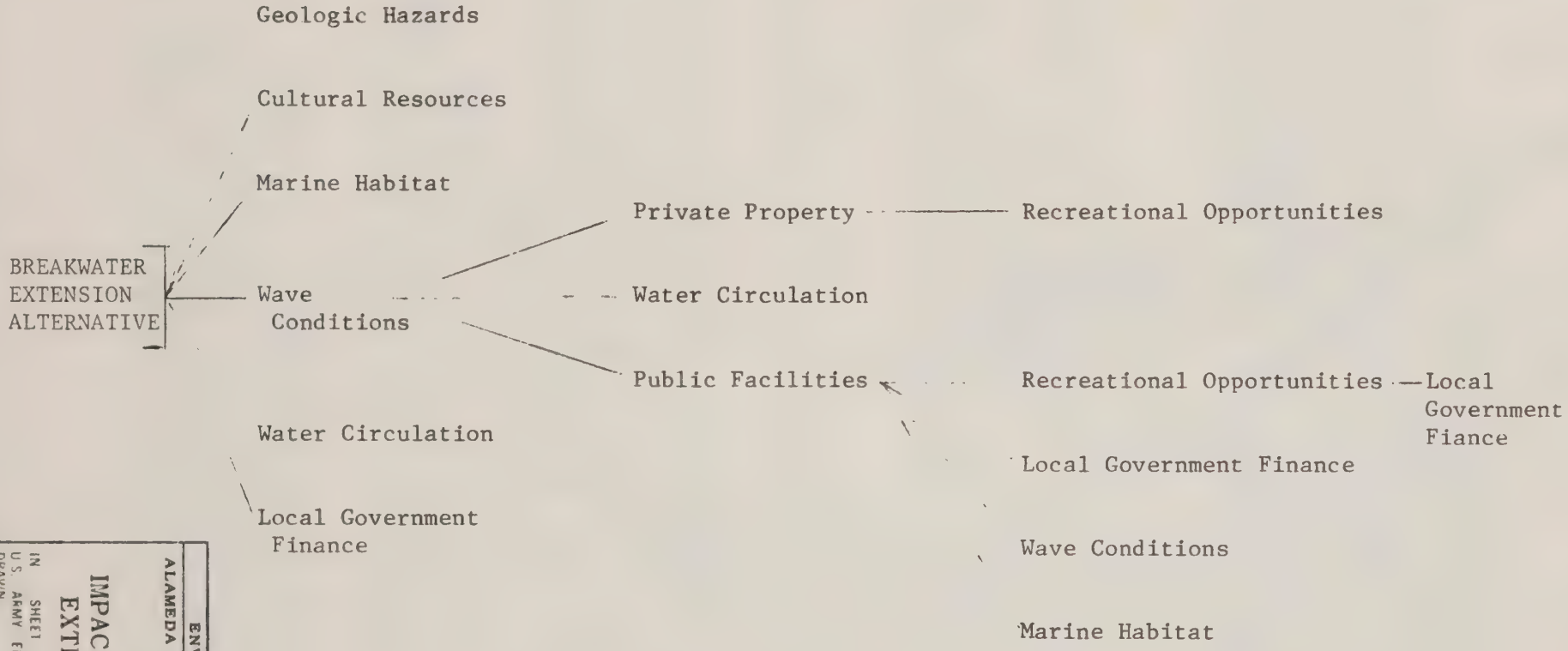
(3) Water Quality. Since the water circulation is not expected to be affected by the breakwater extension, the water quality would not experience any significant change.

(4) Sedimentation. Although no model studies have been made concerning the sedimentation behind the completed breakwater extension, the alternative is not expected to have much of an effect on sedimentation since no pronounced littoral current operates along the study area. Some sedimentation is currently taking place between the existing detached breakwater and the north jetty and future conditions with a completed alternative is expected to be approximately the same with shoaling taking place behind the breakwater.

(5) Geologic Hazards. The completed alternative is not expected to be affected to any significant degree by geologic hazards. In case of a major seismic event like an earthquake, some settlement of a rubble-mound breakwater founded on bay mud might be expected but it would pose no threat on human life and/or property.

c. Effects on the Biotic Environment. The breakwater extension would involve direct impacts on marine bottom habitat. Loss of bottom-dwelling invertebrates would occur. Actual extent of the loss would be determined by the estimated area occupied by the extension. A steel, concrete, or timber sheet-pile breakwater extension would occupy less area on the bottom of San Francisco Bay with less dredging for the

IMPACT TREE
BREAKWATER EXTENSION ALTERNATIVE
BERKELEY MARINA



NOTE: The lines in this illustration are to be read as:
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- - - - Does not have a significant effect on . . .

ENVIRONMENTAL STATEMENT
ALAMEDA COUNTY CALIFORNIA
BERKELEY MARINA
IMPACT TREE – BREAKWATER EXTENSION ALTERNATIVE
IN U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
SHEET NO
DRAWN
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TO ACCOMPANY REPORT
DATED JUNE 1977
FILE NO.

PLATE 8

foundation and these variations would therefore have less of an impact on the bottom-dwelling organisms. A rubble-mound structure, however, does permit other marine organisms to utilize small areas of the irregular surface for shelter and protection. Although loss of benthos would result, replacement by a littoral habitat-type would take place over time.

d. Effects on the Socio-Economic Environment.

(1) Recreational Opportunities. If the breakwater extension alternative were implemented, it would mean an improvement in the boating opportunities for boatowners berthing boats in Berkeley Marina. With an extended breakwater the wave energy inside the harbor would be reduced considerably thus reducing future damages to piers, berths, and small-craft. Consequently, the eventual future abandonement of these facilities and the movement of exposed boats to other marinas around the bay would be prevented. Thus the implementation of this alternative would have a beneficial impact on the future boating opportunities for residents of the Berkeley area. The shoal in the north passage would however continue to be a navigational hazard that would somewhat limit boating opportunities to periods when favorable weather and tidal conditions exist.

(2) Cultural Resources. The alternative is not expected to have any impacts on cultural resources within the study area. There are no known archaeologic, historic, or palenontological resources within or immediately adjacent to the project area. The existence of significant submerged cultural resources is considered remote.

(3) Public Facilities. Implementation of the alternative would have a beneficial impact on the public facilities in the study area. The publicly owned and operated piers and berths in the marina would be protected from further deterioration and would thus be able to better serve the boating public.

(4) Private Property. The breakwater extension alternative would be beneficial to owners of private property, i.e. boats, berthed at Berkeley Marina. With the wave energy dissipated by the breakwater extension, the wave action would be reduced, and consequently future damages to small-craft in the harbor would be mitigated.

(5) Local Government Finance. Implementation of the breakwater extension alternative would affect the finances of the City of Berkeley in three ways. First, there is the expenditure of from $200,000 to $400,000 (depending on which variation of the alternative is selected) for the local share of the first cost for constructing the breakwater extension. Second, since the marina would be used at 100%

capacity for the life of the project, the city would realize continued maximum revenue. Third, since the damage to and the deterioration of the piers and the berths would be arrested due to the reduced wave action inside the harbor, the city would realize a savings due to the longer life of city-owned public facilities.

E. FLOATING BREAKWATER ALTERNATIVE

1. Description of the Alternative.

The concept of this alternative is to utilize a floating breakwater extension to reduce the wave energy of incoming waves. Under this alternative either a permanently anchored or movable floating breakwater could be employed.

A permanently anchored floating breakwater extension would be about the same size and in about the same location as would a solid breakwater extension. There are a number of designs of floating breakwaters available but they must at this time be considered experimental. A common type of a permanently anchored floating breakwater basically consists of a mat of plastic or nlyon spheres floating on the water surface. Each sphere is connected to an anchoring device on the bottom of the water body. As the waves pass through the mat of spheres, the wave energy is dissipated and the wave height is reduced.

A floating movable breakwater extension could be floated or designed to swing across the north passage entry only when needed to block waves coming from certain sectors. Such floating breakwaters made from old tires have been used in a number of marinas.

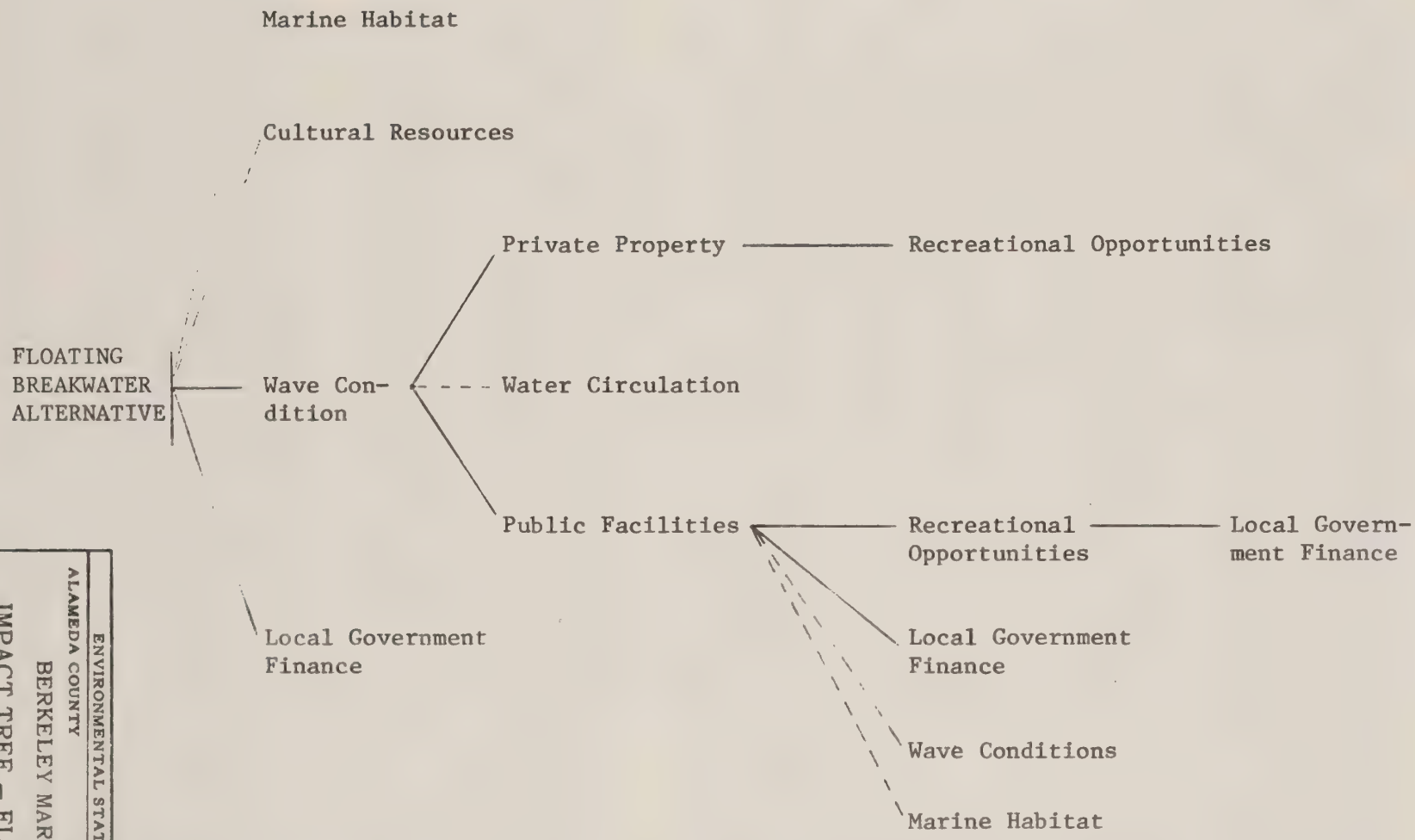
The floating breakwater alternative is a structural management measure that addresses the planning objective that calls for a reduction in damages to privately owned boats and publicly owned marina facilities due to wave action inside the harbor.

The total first cost of the floating breakwater alternative is estimated to be approximately $210,000. It should be noted however, that floating breakwaters generally require more maintenance than solid breakwaters thus increasing costs over the life of the project.

2. Impacts of the Floating Breakwater Alternative.

a. Introduction. An impact tree, tracing the cause and effect relationships of the floating breakwater alternative, was constructed to trace the impacts associated with this alternative. The significant impacts and impacts of the first level of insignificance thusly identified are described in the sections that follow. Unless otherwise stated, the impacts discussed apply to both variations of the floating breakwater alternative. The impact tree on Plate 9 is based on the environmental relationship matrix shown on page 16.

IMPACT TREE
FLOATING BREAKWATER ALTERNATIVE
BERKELEY MARINA



NOTE: The lines in this illustration to be read as:
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- - - - - Does not have a significant effect on ...

ENVIRONMENTAL STATEMENT
ALAMEDA COUNTY CALIFORNIA
BERKELEY MARINA
IMPACT TREE - FLOATING BREAKWATER ALTERNATIVE
IN SHEET NO. OF SHEETS
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
DRAWN:
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TO ACCOMPANY REPORT DATED JUNE 1977
FILE NO.

PLATE 9

b. Effects on the Physical Environment. Implementation of either of the variations of the floating breakwater alternative would have a significant impact on the wave conditions inside the harbor during periods of wave trains arriving from the west-northwest. With a floating breakwater in place, the energy of the incoming waves from WNW would be dissipated to various degress depending on the breakwater and the type of waves arriving. Floating breakwaters, generally are much more effective in reducing short-period waves (choppy waves) than long-period swells. Therefore, it is estimated that the long-period swells from the west-northwest, those primarily responsible for the wave damage inside the harbor, would only be reduced by about 40 percent. The floating breakwater alternative is not expected to have any significant impact on the water circulation in and around Berkeley Marina.

c. Effects on the Biotic Environment. The permanently anchored floating breakwater would involve the placement of a series of anchors imbedded in the bottom of the bay. The placement of such anchors would result in some disturbance of the bottom habitat. However, the bottom habitat would not be covered nor significantly altered. The tidal movement of the water would not be changed nor blocked from existing flow and fish passage would not be restricted by the floating breakwater. A floating breakwater would not have much effect on marine resources since no significant subsurface changes would occur as a result of this alternative.

d. Effects on the Socio-Economic Environment.

(1) Public Facilities. Implementation of this alternative would be beneficial to the public facilities in the marina. The floating breakwater would protect the piers and the berths in the harbor from wave-induced damage and it would thus extend the life of these facilities, which will assure that such facilities would be utilized to full capacity for the project life.

(2) Private Property. This alternative would have a beneficial impact on such private property as small-craft berthed inside the harbor since a floating breakwater would protect the marina from damaging waves.

(3) Recreational Opportunities. The floating breakwater alternative would have a beneficial impact on pleasure boating in the study area in the sense that the continued utilization of the marina to 100% capacity would allow the fullest possible use of public facilities for boating for the life of the project. Also, this alternative would protect privately-owned boats in the marina from wave-induced damage thus preventing the loss of boat-time while the craft are repaired.

(4) Local Government Finance. With a completed alternative, the marina would operate with 100% occupancy of the berths. This would mean continued revenue for the city as compared with the no

action alternative. On the other hand, the city would have to expend funds in the amount of from $100,000 to $200,000 for its share in the contruction of the alternative. Since the longevity of floating breakwaters is unknown, the local government is also facing unknown future maintenance costs. Also, since incoming long-period waves would only be reduced by 40 percent by a floating breakwater, some damage to the piers and berths inside the harbor would still occur creating unknown future maintenance costs for the city.

In addition, if the movable floating breakwater alternative were implemented, the cost of operating and maintaining the structure would have to be borne by the City of Berkeley.

(5) Cultural Resources. Implementation of the floating breakwater alternative is not expected to have any significant impact on any cultural resources in the study area.

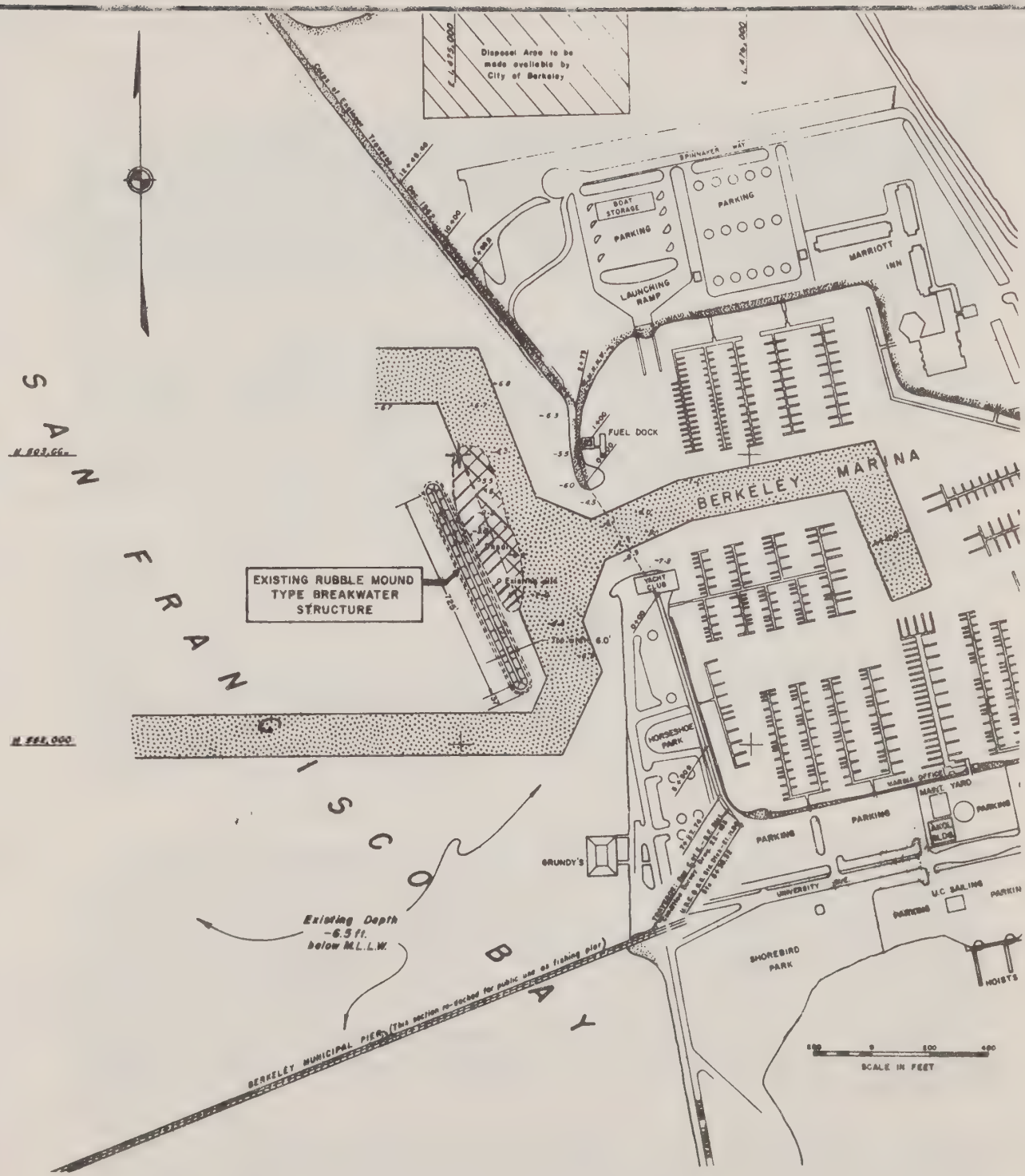
F. THE DREDGING ALTERNATIVE

1. Description of the Alternative.

The concept of this alternative is to deepen the water inside and outside the harbor to make Berkeley Marina more accessible to boaters. This alternative has been conceived in two variations, the dredging of the north passage only, and the dredging of a designated access channel, which includes both the north and the south entrances (See Plate 10).

Under the first variation, only the north passage would be dredged to remove the shoal that has formed between the existing detached breakwater and the north jetty as shown on Plate 10. If this variation were implemented, it would mean that approximately 12,000 cubic yards of bottom material would have to be dredged and disposed of either at the Alcatraz disposal site or at the land disposal site within the study area. The locations of the disposal sites are shown on Figure 1, page 5 (Alcatraz) and Plate 10 (Sanitary Landfill). Implementation of this variation of the dredging alternative would be a local responsibility.

A designated access channel is the second variation of the dredging alternative. This 150-foot wide, 4,500-foot long channel would be dredged to a depth of eight feet. The designated access channel would run from inside the harbor out to the eight-foot depth of San Francisco Bay as shown on Plate 10. If this variation were implemented, it would mean that approximately 150,000 cubic yards of bottom material would have to be dredged and disposed of either at the Alcatraz disposal site or at the land disposal site within the study area. The designated access channel would improve the navigational access to Berkeley Marina



LEGEND

- EXISTING SHOAL
- AREA TO BE DREDGED FOR NORTH PASSAGE VARIATION
- AREA TO BE DREDGED FOR DESIGNATED CHANNEL

ENVIRONMENTAL STATEMENT

ALAMEDA COUNTY CALIFORNIA

BERKELEY MARINA

DREDGING ALTERNATIVE

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E

FILE NO.

TO ACCOMPANY REPORT DATED JUNE 1977

PLATE 10

through both the north and the south passages. If a designated access channel were established for Berkeley Marina, the Corps of Engineers would be responsible for the Federal share of the first cost of the dredging as well as for the maintenance dredging that would be required in the future to keep the designated access channel open for recreational boating.

The dredging alternative is a management measure that addresses the planning objectives that call for the improvement of navigational safety and conveniance at the entrance to Berkeley Marina and the increase of opportunities for recreational boating.

The estimated cost of the two variations of the dredging alternative are as follows:

Dredging of north passage = $ 50,000
Dredging of designated channel = $388,000

It should be noted that if only the north pasage is dredged the subsequent maintenance costs for dredging would be a local responsibility since it would not be eligible for Federal assistance.

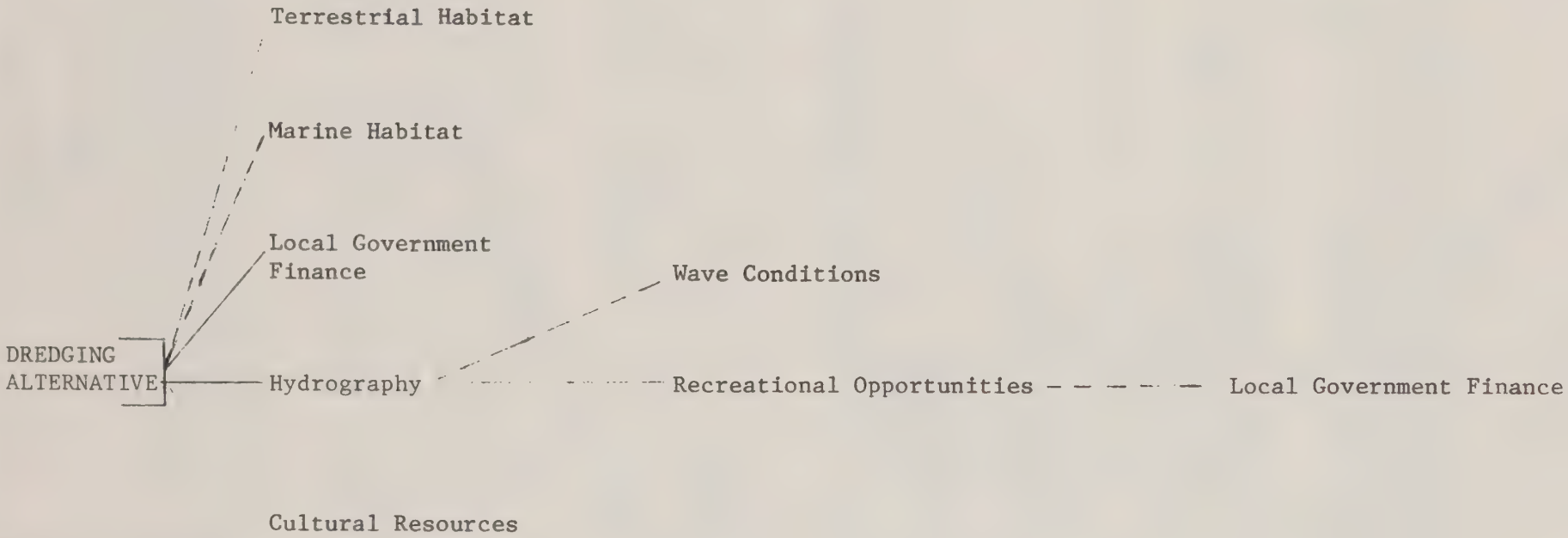
2. Impacts of the Dredging Alternative.

a. Introduction. An impact tree, tracing the cause and effect relationships of the dredging alternative, was constructed to trace the significant impacts associated with the alternative. The significant impacts and impacts of the first level of insignificance thusly identified are described in the sections that follow. Unless otherwise stated, the impacts discussed apply to both variations of the dredging alternative. The impact tree on Plate 11 is based on the environmental relationship matrix shown on page 16.

b. Effects on the Physical Environment. The dredging alternative is not expected to have any long term significant impacts on the physical environment. The adoption of the dredging alternative would result in a slightly altered bottom configuration. The extent of the impact would vary depending on which one of the variations is implemented. Other effects of dredging are temporary and include, but are not limited to, increased turbidity, chemical and biological reactions in the water column, and lowering of local dissolved oxygen concentrations.

c. Effects on the Biotic Environment. Either one of the dredging variations would result in removal of bottom habitat and disposal of material, either at an aquatic site near Alcatraz or at a land site within the study area. While short-term effects would occur at the aquatic site, long-term effects may be sustained at the land disposal site.

IMPACT TREE
DREDGING ALTERNATIVE
BERKELEY MARINA



NOTE: The lines in this illustration to be read as:
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ENVIRONMENTAL STATEMENT
ALAMEDA COUNTY CALIFORNIA
BERKELEY MARINA
IMPACT TREE – DREDGING ALTERNATIVE
IN SHEET
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
DRAWN SHEET NO.
TRACED: FILE NO.
CHECKED TO ACCOMPANY REPORT
DATED JUNE 1977

PLATE 11

d. Effects on the Socio-economic Environment.

(1) Recreational Opportunities. The implementation of either of the variations of the dredging alternative would have a beneficial impact on recreational opportunities, specifically the boating opportunities in the study area. The access to Berkeley Marina would be improved through the removal of the navigational hazards represented by shallow depths present in both the north passage and in the southern approach to the entrance into the marina. With this alternative completed, the 40 percent of the small-craft that presently are restricted in their movements in and out of Berkeley Marina would be able to enter and leave the harbor under almost all tidal conditions. Thus the boating opportunities would be increased for boats berthed in the marina.

(2) Local Government Finance. Implementation of the designated access channel variation of the alternative would obligate the city to pay 50% of the first cost of dredging. The Federal government would pay future maintenance costs to keep the channel open. If the variation that calls for the dredging of the north passage were selected, it would be a local responsibility.

SECTION 5

PRELIMINARY EVALUATION

A. INTRODUCTION

The planning task of evaluation determines both beneficial and adverse contributions of each management measure. The present iteration of planning tasks for the study of Berkeley Marina is the first in which any real assessment of impacts has been attempted and therefore the evaluation is very preliminary. The planning task of evaluation will eventually be the basis for selecting the most desirable plan in the last iteration of the planning tasks. The intermediate stage of the planning process will not be completed until the task of evaluation is completed. Since the evaluation procedures require a variety of information sources and a continuous feedback, this working paper is a step in completing the task of evaluation. Review of this working paper will test the adequacy of the identification of effects, validate their designation as beneficial or adverse, and provide commentary on measures for project modification. It will insure that effects have not been overlooked or that the significance of effects has not been misjudged.

B. DISPLAY OF IMPACTS

In the display of impacts that follows, three different matrices are displayed. These matrices are summations of the impacts identified in the impact trees and in the discussion of each management measure. The "no action" alternative or future conditions without a project, is used as a basis for comparing the impacts of the management measures and the alternative plans of action developed.

Matrix Number 1, which is shown on pages 30 and 31, displays the impacts associated with each management measure. All items which are required to be addressed under Section 122 of the River and Harbor and Flood Control Act of 1970 (Public Law 91-611; 84 Stat. 1818) are included in this matrix. Items marked with * in Matrix Number 1 identifies items of public concern. Matrix Number 2 which is shown on page 32 displays the impacts associated with each alternative plan of action. The alternative plans of action were developed by combining different management measures. Only significant impacts are shown on this matrix.

In the present iteration of the planning tasks, the impact assessment is very preliminary. In future iterations of the planning task of impact assessment, every effort will be made to quantify the impacts in the display.

MATRIX NUMBER 1
IMPACTS OF MANAGEMENT MEASURES

CHARACTERISTICS	Permanent Relocation	Temporary Relocation	Breakwater Extension Rubble-mound	Breakwater Extension Sheet Pile	Floating Breakwater Moveable	Floating Breakwater Anchored	Dredging North Passage	Dredging Designated Access channel	No Action
PHYSICAL IMPACTS									
Hydrography	0	0	0	0	0	0	0	+2	0
Pedology	0	0	0	0	0	0	0	0	0
Air Quality	0	0	0	0	0	0	0	0	0
Traffic	0	0	0	0	0	0	0	0	0
Noise	0	0	0	0	0	0	0	0	0
Wave Conditions	0	0	+2	+2	+2	+2	0	0	0
Water Circulation	0	0	0	0	0	0	0	0	0
Sedimentation	0	0	UK	UK	0	0	0	0	0
Water Quality*	0	0	0	0	0	0	0	0	0
BIOTIC IMPACTS									
Marine Habitat*	0	0	-1	0	0	0	0	-1	0
Shoreline Habitat*	0	0	0	0	0	0	0	0	0
Terrestrial Habitat*	0	0	0	0	0	0	0	0	0
Rare & Endangered* Species	0	0	0	0	0	0	0	0	0

LEGEND:
+2 Highly Positive Effect
+1 Moderately Positive Effect
0 Little or no Effect
-1 Moderately Negative Effect
-2 Highly Negative Effect

* Indicates items of public concern
UK Unknown impact

MATRIX NUMBER 1
IMPACTS OF MANAGEMENT MEASURES

CHARACTERISTICS SOCIO-ECONOMIC IMPACTS	Permanent Relocation	Temporary Relocation	Breakwater Extension Rubble-mound	Breakwater Extension Sheet Pile	Floating Breakwater Moveable	Floating Breakwater Anchored	Dredging North Passage	Dredging Designated Access channel	No Action
Cultural Resources	0	0	0	0	0	0	0	0	0
Recreational Opportun.*	0	0	+1	+1	+1	+1	+1	+1	-1
Aesthetic Quality*	0	0	0	0	0	0	0	0	0
Natural Resources	0	0	0	0	0	0	0	0	0
Man-made Resources	0	0	0	0	0	0	0	0	0
Desirable Community Gr.	0	0	0	0	0	0	0	0	0
Desirable Regional Gr.	0	0	0	0	0	0	0	0	0
Local Government Finance*	UK	0	UK	UK	UK	UK	UK	UK	UK
Business & Industrial Activity	0	0	0	0	0	0	0	0	0
Employment/Labor Force	0	0	0	0	0	0	0	0	0
Property Values	0	0	0	0	0	0	0	0	0
Tax Revenue	0	0	0	0	0	0	0	0	0
Public Facilities*	0	0	+2	+2	+2	+2	0	0	-1
Public Services	0	0	0	0	0	0	0	0	0
Displacement of People	0	0	0	0	0	0	0	0	0
Community Cohesion	0	0	0	0	0	0	0	0	0
Private Property*	+1	+1	+2	+2	+2	+2	0	0	-1

LEGEND:
+2 Highly Positive Effect
+1 Moderately Positive Effect
0 Little or no Effect
-1 Moderately Negative Effect
-2 Highly Negative Effect

* Indicates items of public concern
UK Unknown impact

MATRIX NUMBER 2
IMPACTS OF ALTERNATIVE PLANS

CHARACTERISTICS	No Action	Relocation of Boats 1/	Relocation of Boats & Dredging of North Passage 1/	Relocation of Boats & Dredging of Designated Access Channel 1/	Floating Breakwater	Floating Breakwater & Dredging of North Passage	Floating Breakwater & Dredging of Designated Access Channel	Breakwater Extension	Breakwater Extension & Dredging of North Passage	Breakwater Extension & Dredging of Designated Access Channel	Dredging of North Passage	Dredging of Designated Access Channel
PHYSICAL IMPACTS												
Hydrography	0	0	0	0	0	0	0	0	0	0	0	0
Wave Conditions	0	0	0	0	+2	+2	+2	+2	+2	+2	0	0
BIOTIC IMPACTS												
Marine Habitat	0	0	0	-1	0	0	-1	-1	-1	-1	0	-1
SOCIO-ECONOMIC IMPACTS												
Recreational Opp.	0	0	0	0	+2	+2	+2	+2	+2	+2	+1	+1
Local Gov. Finance	0	0	0	0	0	0	0	0	0	0	0	0
Public Facilities	0	0	0	0	+2	+2	+2	+2	+2	+2	0	0
Private Property	0	+1	+1	+1	+2	+2	+2	+2	+2	+2	0	+1
Benefit/Cost Ratio 2/-		UK	UK	UK	1.2	1.0	0.91	1.1	0.94	0.86	UK	0.58

LEGEND:
+2 Highly Positive Effect
+1 Moderately Positive Effect
0 Little or no Effect
-1 Moderately Negative Effect
-2 Highly Negative Effect
UK Unknown

1/ The impacts shown are based on the variation that calls for the permanent relocation of the exposed boats.

2/ The proportion of estimated average annual benefits to average annual costs.

C. EVALUATION CRITERIA

Matrix Number 3, which is shown on page 35, tests the responsiveness of the various alternative plans of action to certain evaluation criteria. These criteria are described as follows:

(1) Acceptibility.

Acceptability of a plan is determined by analyzing its acceptance by concerned publics. A plan is acceptable if it is, or will likely be, supported by some significant segment of the public. However, during reiterations of the planning tasks, every attempt should be made to eliminate, to the extent possible, unacceptability to any significant segment of the public. The acceptability of the plans will be determined at this upcoming public meeting and through comments submitted on this working paper.

(2) Completeness.

The completeness of a plan is determined by analyzing whether all necessary investments or other actions necessary to assure full attainment of the plan have been incorporated.

(3) Effectiveness.

The effectiveness of a plan is determined by analyzing the technical performance of a plan and its contributions to the planning objectives. The planning objectives are numbered as follows:

Objective 1: Reduction of damages to boats and berthing facilities.
Objective 2: More intensive use of boats berthed in Berkeley Marina.
Objective 3: Improvement in navigational safety in the entrance to Berkeley Marina.

(4) Efficiency.

The efficiency of a plan is determined by analyzing its benefit-to-cost ratio.

(5) Certainity.

The certainity of a plan is determined by analyzing in general terms the likelihood that if the plan is implemented, the planning objectives will be attained.

(6) Geographic Scope.

The geographic scope is determined by analyzing the relevancy of the geographic area encompassed by the plan; it must be large enough to encompass a full understanding of the problems and focused enough to make the proposed solutions effective.

(7) Reversibility.

The reversibility of a plan is determined by analyzing the capability, as public needs and values change or should unusal future circumstances so warrant, of restoring the partially or fully implemented plan to approximate the without condition.

(8) Stability.

The stability of a plan is determined by analyzing the range of alternatives futures, data and/or assumptions which can be meaningfully accommodated within the recommended plan or minor modifications thereof. Greater stability generally indicates a more desirable plan.

MATRIX NUMBER 3
EVALUATION OF ALTERNATIVE PLANS
IN TERMS OF RESPONSIVENESS

EVALUATION CRITERIA	No Action	Relocation of Boats	Relocation of Boats & Dredging of North Passage	Relocation of Boats & Dredging of Designated Access Channel	Floating Breakwater	Floating Breakwater & Dredging of North Passage	Floating Breakwater & Dredging of Designated Access Channel	Breakwater Extension	Breakwater Extension & Dredging of North Passage	Breakwater Extension & Dredging of Designated Access Channel	Dredging of North Passage	Dredging of Designated Access Channel
Acceptability	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK
Completeness	2	1	1	1	1	1	1	1	1	1	0	0
Effectiveness												
Objective 1	0	1	1	1	1	1	1	2	2	2	1	1
Objective 2	0	0	1	1	1	1	2	1	2	2	1	1
Objective 3	0	0	1	2	0	1	2	0	1	2	1	2
Efficiency	UK	UK	UK	UK	2	2	1	2	1	1	UK	0
Certainty												
Objective 1	0	1	1	1	1	1	1	2	2	2	0	0
Objective 2	0	0	0	1	1	1	1	1	1	1	1	1
Objective 3	0	0	0	0	0	0	1	1	1	2	1	2
Geographic Scope	2	2	2	2	2	2	2	2	2	2	2	2
Reversibility	2	2	2	2	2	2	2	0	0	0	2	2
Stability	2	2	2	2	2	2	2	0	0	0	2	2

LEGEND: The numbers shown indicate responsiveness in percentage as follows: 2=100% -75%; 1=75% -25%; 0=25% -0%; UK = Unknown

D. DISPLAY OF COSTS AND BENEFITS

Cost and benefits of the various alternative plans of action are summarized in Table 2 which follows:

TABLE 2

DISPLAY OF COSTS AND BENEFITS 1/

ALTERNATIVE PLANS	Total First Cost	Local Cost	Average Annual Cost	Average Annual Benefits	B/C Ratio
No Action	N/A	N/A	N/A	N/A	N/A
Relocation of Boats	Unknown	Unknown	Unknown	Unknown	Unknown
Relocation of Boats & Dredging of North Passage	Unknown	Unknown	Unknown	Unknown	Unknown
Relocation of Boats & Dredging of Designated Access Channel	Unknown	Unknown	Unknown	Unknown	Unknown
Floating Breakwater 4/	210,000	105,000	26,000	31,400	1.2:1
Floating Breakwater & Dredging of North Passage 4/	260,000	155,000	31,000	31,400	1.0:1
Floating Breakwater & Dredging of Designated Access Channel 4/	595,000	287,500	47,200	43,000	0.9:1
Breakwater Extension 2/	660,000	330,000	50,700	52,400	1.1:1
Breakwater Extension & Dredging of North Passage 2/	710,000	380,000	55,700	52,400	0.94:1
Breakwater Extension & Dredging of Designated Access Channel 2/	1,013,000	500,000	84,600	73,400	0.86:1
Dredging of North Passage 1/	50,000	50,000	5,000	Unknown	Unknown
Dredging of Designated Access Channel	388,000	194,000	36,000	21,000	0.58:1

1/ All costs are preliminary in nature but considered adequate for a relative comparison between the various alternative plans.
2/ Cost estimate based on a 200-foot long rubble-mound breakwater.
3/ Local obligation for maintenance and not eligible for Federal assistance.
4/ Cost estimate based on a permanently anchored floating breakwater.

E. CONFORMANCE WITH LAND USE PLANS

All of the alternative plans of action conform with all known land use plans for the study area.

F. ENVIRONMENTAL STATEMENT

The requirement for an environmental statement may depend upon which of the alternative plans of action is selected. After a plan is selected, an environmental assessment will be conducted to determine the need for an environmental statement. The assessment will identify all significant adverse impacts. If such impacts are identified, then an environmental statement must be made. If, however, no significant adverse impact is identified, concerned agencies will be contacted to identify any objections or controversy. If after this coordination, no significant adverse impact or controversy is identified, then a negative declaration will be made stating that an environmental statement will not be required. Comments on this working paper will be used to identify significant impacts and controversies.

G. BASIS FOR THE NEXT ITERATION

Based on the input provided by comments on this working paper, and through statements made at the upcoming public meeting, the next iteration of the planning tasks will be initiated. The next iteration will reformulate and refine the planning objectives and restrict and reformulate the array of potential alternatives to minimize adverse environmental effects while addressing the refined project objectives. The next iteration will either investigate (1) the possibility of eliminating significant adverse effects, (2) mitigating an effect by minimizing or reducing it to an acceptable level of intensity or (3) by compensating for an adverse effect by including a counter-balancing positive effect.

The next iteration of the planning tasks will be in the third stage of the planning process where the alternatives will be screened and detailed plans will be developed as a basis for the final selection and recommendation.

SECTION 6

COORDINATION

The views and suggestions of Government agencies, public and private organizations and interested individuals have been and will be sought and considered. It is hoped that this working paper will establish a firmer and more meaningful coordination, prior to the Draft Environmental Statement, should one be needed, by generating comments from other governmental agencies, conservation groups, and private citizens. All comments will be considered and evaluated during the more detailed further planning and in any Draft Environmental Statement.

Informal coordination has been accomplished with the Environmental Protection Agency (EPA) regarding possible impacts on air and water quality in the study area. It was agreed that none of the proposed alternative plans would have an adverse impact on air quality. EPA has not yet made a determination regarding the dredging alternative but it has no objection to any of the other alternatives because of possible impact on water quality.

The existence of significant submerged cultural resources is considered remote. In compliance with Section 106 of the National Historic Preservation Act of 1966 (16 USC 470 (f), the most recent listing of the National Register of Historic Places (Federal Register, February 1976 with monthly supplements) has been consulted and determination has been made that no National Register property, or property eligible for nomination to the National Register, will be affected either directly or indirectly, by the proposed project. In compliance with Executive Order 11593 of 13 May 1971, the California State Office of Historic Preservation was contacted and determination was made that no State Historical Landmarks or State Points of Historical Interest will be affected, either directly or indirectly, by the proposed project.

No public meetings have been held except for informal meetings and workshops with the harbor master and boaters. A public meeting will follow the distribution of this working paper.

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APPENDIX A

SHOREBIRD SURVEY CHECKLIST

Common Name	Scientific Name	Occurence at Site*
Semipalmated plover	Charadrius semipalmatus	Very limited
Snowy plover	Charadrius alexandrinus	very limited
Killdeer	Charadrius vociferus	moderate
Black-bellied plover	Squatarola squatarola	numerous
Ruddy turnstone	Arenaria interpres	very limited
Black turnstone	Arenaria melanocephala	limited
Common snipe	Capella gallinago	very limited
Long-billed curlew	Numenius americanus	limited
Whimbrel	Numenius phaeopus	very limited
Spotted sandpiper	Actitis macularia	very limited
Willet	Catoptrophorous semipalmatus	very numerous
Knot	Calidris canutus	limited
Greater yellowlegs	Totanus melanoleucus	very limited
Lesser yellowlegs	Totanus flavipes	very limited
Least sandpiper	Erolia minutilla	moderate
Western sandpiper	Ereunetes mauri	very numerous
Dunlin	Erolia alpina	very numerous except winter
"Peeps"	Small sandpipers - unidentified	very numerous
Short-billed dowitcher	Limnodromus griseus	numerous
Long-billed dowitcher	Limnodromus scolopaceus	very limited
Dowitchers	all dowitchers - unidentified	very numerous except May-June
Marbled godwit	Limosa fedoa	moderate
Sanderling	Crocethia alba	moderate
American avocet	Recurvirostra americana	numerous
Northern phalarope	Lobipes lobatus	very limited

*Interpretation:

Very limited - Less than 10 in number/month; sighted 6 months or less
Limited - Less than 20 in number/month; sighted less than 12 months
Moderate - Less than 500 in number/month; sighted less than 12 months
Numerous - Greater than 500 in number/month; sighted up to 10-11 months
Very numerous- Greater than 1,000 in number/month; sighted up to 12 months

APPENDIX B

MARINA DEVELOPMENTS

Existing Improvements Owned and Operated by the Marina. (City of Berkeley)

Berkeley Municipal Fishing Pier (free public use)
Marina administrative office and harbor control tower
Maintenance building and yard
Public restrooms on fishing pier and at harbor
Boat launching ramp (fee $1.00 per launch)
Floating berths of various size and rates from $25.00 per month for single finger 20-foot berth to $105 per month for single finger 84-foot berth. Total 980 berths, most with lockers and utilities, including fire protection
Fenced dry storage yard for 90 boats (filled to capacity)
Paved streets and 1,600 parking spaces
Dock for commercial harbor tour boats
Two boats hoists - 1,000 lb and 4,000 lb capacity
Docking accommodation for about 20 sport fishing boats and sea scout ship
Houseboat area with all utilities
Extensive landscaping and lighting
Miscellanous aids to navigation in harbor
Marine Communications

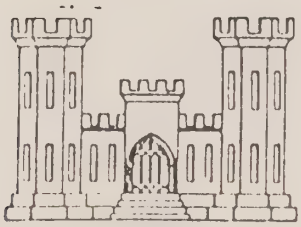
Privately-Owned and Concessionnaire-Operated Facilities On Leased Land

Berkeley Yacht Clubhouse
Marine fuel and service station (Arco Richfield lease)
Bait and tackle shop housed in double wide trailer house
Marriott Inn - 300 rooms with banquet rooms and coffee shop, 800 feet of guest berthing floats
Solomon Grundy's Restaurant
His Lordship Restaurant
Marine-related business office buildings

Marina Developments In Active Planning And Negotation Stages

Boat repair and chandlery shop
Additional landscaping
Possible future increase in berthing accommodation for sail boats in South Basin
Permanent building for bait, tackle and coffee shop
Multi-purpose clubhouse building for U.C. sailing club, senior citizens, scouts and other community organizations

DEPARTMENT OF THE ARMY
SOUTH PACIFIC DIVISION, CORPS OF ENGINEERS
LABORATORY



BERKELEY MARINA BREAKWATER EXTENSION

ANALYSIS OF SEDIMENTS AND DISPOSAL SITE WATER

SAUSALITO, CALIFORNIA
December 1976

BERKELEY MARINA BREAKWATER EXTENSION

ANALYSIS OF SEDIMENTS AND DISPOSAL SITE WATER

December 1976

AUTHORIZATION

1. Results of tests reported herein were requested by DA Form 2544, No.E86-77-3011, dated 23 November 1976.

PURPOSE

2. The purpose of this study was to determine the amount of specified pollutants in samples of bottom sediments and added to the disposal site water in elutriate test procedure. Also requested were visual classification of all bottom sediment samples and gradation analyses of samples containing sand size particles.

SAMPLES

3. Twelve sediment samples in plastic tubes, eight sediment samples in plastic bags, and dredge and disposal site waters in gallon cubitaners were received on 23 November 1976.

TEST METHODS

4. a. Bulk Sediment Analysis. Mercury, cadmium, lead, zinc, and oil and grease were run according to "Preliminary Sampling and Analytical Procedures for Evaluating the Disposal of Dredged Materials", Laboratory Support Branch, Environmental Protection Agency, Region IX, April 1974.

b. Standard Elutriate Test. The test was run according to 40 CFR, Part 230, "Discharge of Dredge or Fill Material in Navigable Waters", Environmental Protection Agency. The mercury, cadmium, lead, zinc, and oil and grease were run according to methods for "Chemical Analysis of Water and Wastes", Environmental Protection Agency, National Environmental Research Center, Analytical Control Laboratory, Cincinnati, Ohio, 1974.

c. Visual classification and Gradation Analyses were run according to Engineering Manual 1110-2-1906.

TEST RESULTS

5. Test Results are presented as follows:

a. Bulk Sediment Analyses and Standard Elutriate Test results are presented on forms supplied by the San Francisco District.

b. Results of visual classification tests are presented on Plates 1 and 2.

c. Results of gradation analyses are presented on Eng. Forms 2087.

COMMENTS

6. All samples were within the maximum limits set by the Environmental Protection Agency, Region IX, for Marine (shallow) and Estuarine water disposal and 40 CFR, Part 230, Section 230.4.3.

CHEMICAL TESTS OF SAMPLES

NAME & ADDRESS
OF LABORATORY: South PacificDivision
P.O.Box 37,Sausalito, CA. 94965
UNIT OF MEASUREMENT: mg/l

PROJECT TITLE: Berkeley Harbor Breakwater
DATE OF SAMPLE: 17-19 November 1976
TYPE OF TEST (Bulk Sediment Analysis
or Standard Elutriate): Standard Elutriate

SAMPLE NO.	SAMPLE DEPTH	MERCURY	CADMIUM	LEAD	ZINC	OIL & GREASE
2D-12	0.0'-3.0'	0.0003	0.03	0.06	0.07	0.4
"	3.0'-6.0'	0.0003	0.03	0.06	0.07	0.4
2D-13	0.0'-3.0'	0.0003	0.03	0.06	0.07	0.4
"	3.0'-6.0'	0.0003	0.03	0.06	0.07	0.4
2D-14	0.0'-3.0'	0.0003	0.03	0.06	0.07	0.5
"	3.0'-6.0'	0.0003	0.03	0.06	0.07	0.4
"	6.0'-9.0'	0.0003	0.03	0.06	0.07	0.4
"	9.0'-12.0'	0.0004	0.03	0.06	0.07	0.4
2D-15	0.0'-3.0'	0.0003	0.03	0.06	0.07	0.4
"	3.0'-6.0'	0.0003	0.03	0.06	0.07	0.4
"	6.0'-9.0'	0.0003	0.03	0.06	0.07	0.4
"	9.0'-12.0'	0.0003	0.03	0.06	0.07	0.4
Dredge Site Water		0.0002	0.03	0.06	0.07	0.4
Disposal site water		0.0003	0.03	0.06	0.07	0.4

CHEMICAL TESTS OF SAMPLES

NAME & ADDRESS
OF LABORATORY: South Pacific Division
P.O.Box 37, Sausalito, CA.94965

UNIT OF MEASUREMENT: Parts per million of Dry weight

PROJECT TITLE: Berkeley Harbor Breakwater
DATE OF SAMPLE: 17-19 November 2976
TYPE OF TEST (Bulk Sediment Analysis or Standard Elutriate): Bulk Sediment

SAMPLE NO.	SAMPLE DEPTH	MERCURY	CADMIUM	LEAD	ZINC	OIL & GREASE
2D-12	0.0'-3.0'	0.5	1.3	83	142	980
"	3.0'-6.0'	0.2	1.5	27	57	340
2D-13	0.0'-3.0'	0.3	1.3	57	102	750
"	3.0'-6.0'	0.1	1.2	17	48	120
2D-14	0.0'-3.0'	0.2	1.2	34	64	260
"	3.0'-6.0'	0.1	1.1	16	47	230
"	6.0'-9.0'	0.1	0.9	7	44	120
"	9.0'-12.0'	0.1	0.3	6	14	200
2D-15	0.0'-3.0'	0.2	1.5	39	44	200
"	3.0'-6.0'	0.1	1.2	18	48	140
"	6.0'-9.0'	0.1	1.0	14	43	150
"	9.0'-12.0'	0.1	0.6	10	20	170
EPA max. limits for marine (shallow) and estuarine water		1.5	3.0	180	300	4000